An Empirical Study for Food Consumption in Vietnam

Canh Le Quang

National Economics University

2008

ASEAN Economic Bulletin Vol. 25, No. 3 (2008), pp. 283–92 ISSN 0217-4472 print / ISSN 1793-2831 electronic

DOI: 10.1355/ae25-3c

An Empirical Study of Food Demand in Vietnam

Canh Quang Le

This paper uses a linear approximation of Almost Ideal Demand System (AIDS) and extended AIDS models to investigate food consumption in Vietnam using the Vietnam Living Standard Survey (VLSS) in 2004. In particular, AIDS models are estimated to calculate income and price elasticities for three different components of food categories. Our results suggest that rice food and meat/fish are normal goods, while non-rice food is luxury. Household characteristics such as age, gender, and education do not appear to affect food consumption significantly, while urban/rural location is important. These results may give empirical evidence for policy-makers to design food policy in Vietnam.

Keywords: Almost ideal demand system, uncompensated elasticity, compensated elasticity, Vietnam.

I. Introduction

Food consumption has been a subject of research all over the world. It is especially meaningful in developing countries where food expenditures account for a relatively large share of household income. Studies of food consumption shed light on food-related nutritional policies. They provide estimates of how food consumption is affected by changes in prices, income, and taxation policies (Dunne and Edkins 2005). Food consumption in Vietnam has been an important issue, not only because it is related to poverty, food security, but also because it is highly correlated with living standards and household resources. Vietnam has undergone a shift in the population's diet structure with a decrease in carbohydrates and rice consumption and an increase in protein sources, fruit and vegetables (FAO 1999). The demand for non-food goods and services grows faster than the demand for food. The demand for vegetables, fruit, and meat rises more quickly than the demand for grains and tubers. So studying food consumption can give a better understanding how the demand for food responds to shocks in prices, income, and policies. Given the importance of this issue, there has been surprisingly little research on the demand for food in Vietnam. In a recent contribution, Thang and Popkin (2004) study the patterns of food consumption in Vietnam and its effects on socioeconomic groups, while Hop et al. (2003) focuses particularly on the trends in food productions for the last twenty years. Figuie (2003) analyses vegetable consumption behaviour in Vietnam, while FAO (1999) considers the

relationship between food consumption and nutrition.

This paper uses the Almost Ideal Demand System (AIDS) and the extended AIDS models to investigate food consumptions in Vietnam by using the iterative seemingly unrelated regressions (SUR) and the Ordinary Least Square (OLS) methods. In particular, AIDS models are estimated to calculate income and price elasticities for three different categories of food: rice food, non-rice food, and meat/fish.

The AIDS models have been applied to estimate demands for food and other categories of consumption in different countries. A survey can be found in Dunne and Edkins (2005), Karagiannis et al. (2000), LaFrance and Beatty (2001), Ederton et al. (1996). Some studies focus on specific products. For example, Gibson (1995) focuses on urban demand for food, beverages, betel nut and tobacco; Caswell (1995) studies demand for beef; Eales and Unnevehr (1988) analyzes beef and chicken products.

The rest of this paper is organized as follows: Section II presents model specifications and estimation methods. These models will be used to estimate coefficients of the AIDS model and calculate price and income elasticities of demand for each category of food consumed in Vietnam. Section III provides some general characteristics of food consumption at household level in Vietnam. It also describes the survey for this analysis. In section IV, we present the results and interpretations. Section V gives some discussion and concludes the paper.

II. Model Specification

Estimation of demand for food and services has attracted the attention of economists. Very dense literature is available. Linear Expenditure System (LES) of Stone (1954) is the seminal work of this literature. Some limitations of LES such as proportional income and price elasticities, and no complementary relationship among goods opened doors to the development of other models. Rotterdam model (Theil 1965) and Trandlog model (Christensen et al. 1975) are more flexible models. More recently, Deaton and Muellbauer (1980) have proposed an alternative model which has been named as Almost Ideal Demand System (AIDS).

The AIDS model, being the most popular system in the recent literature, takes all commodity groups and treats them as a singular system. The model can be expressed as follows:

$$w_i = \alpha_i + \sum_k^K \gamma_{ik} \log p_k + \beta_i \log\left(\frac{x}{P}\right) \qquad (1)$$

where $Log\ P = \alpha_0 + \Sigma_k \alpha_k \log p_k + \frac{1}{2}\Sigma_k \Sigma_l \gamma_{lk}$

$\log p_k \log p_l$; K is number of food commodities;

x is total expenditure for food consumption; p_k is price of commodity k^{th}; w_i is expenditure share of commodity i^{th}; and α_i, γ_{ik}, and β_i are parameters.

Some studies have estimated the so-called "extended AIDS" models that can widely explain how demand for food is measured rather than by prices of goods and expenditures. In such model, household characteristics, locations, income quintiles are usually used.

$$w_i = \alpha_i + \sum_l^L \delta_l D_l + \sum_k^K \gamma_{ik} \log p_k + \beta_i \log\left(\frac{x}{P}\right) \quad (2)$$

where L is number of other control variables rather than prices of food commodities and income, and D is control variables such as household characteristics, locations, and income quintiles, and δ is another parameters.

In this study, an approximation of AIDS model is applied to three categories of food products, and each demand function can be presented by their budget shares in total food expenditures and logarithms of income and prices. This system does not include non-food category because the demand for food and non-food commodities are assumed to be weakly separable. The model in equation (1) is independently estimated to compute demand elasticities for each food group, while the model in

equation (2) estimates effects of household characteristics and other control variables rather than price levels and income on demand for food. Both systems are estimated by using the linear approximation for logarithms of general price index: $Log\ P = \Sigma_k w_k \log p_k$, see more in Dunne et al. (1984), and Deaton and Muellbauer (1980). Note that the general price index, *Log P*, can be calculated directly before estimating the main models, so that the non-linear AIDS model in equation (1) becomes a linear one. According to Stone (1954), Deaton and Muellbauer (1980), using the linear approximation for logarithms of general price index naturally satisfies the adding-up restriction because the budget shares add up to one and also satisfies the symmetric condition because demand system is developed from assumptions of rational behaviour. Thus we do not need to impose any cross-equation restrictions in the systems. We only need to carry out the homogeneous test.

Price elasticities can either be derived from the Marshallian demand equation, in which case it is called the uncompensated elasticities, or the Hicksian demand equation named compensated elasticities. These elasticities can be transformed into each other through the Slutsky equation $\varepsilon_{ij}^{H} = \varepsilon_{ij}^{M} + w_j e_i$ where ε^H and ε^M represent the Hicksian and the Marshallian elasticities respectively, w_j is the budget share on good j, and e_i is the income elasticity for good i. The AIDS model implies that the uncompensated cross-price and compensated cross-price elasticities for good i with respect to good j are:

$$\varepsilon_{ij}^{M} = \frac{\gamma_{ij}}{w_i} - \beta_i \frac{w_j}{w_i} - \phi_{ij} \qquad (3)$$

$$\varepsilon_{ij}^{H} = \frac{\gamma_{ij}}{w_i} - w_j - \phi_{ij} \qquad (4)$$

where $\phi_{ij} = 1$ if these equations are used to calculate the own-price elasticities $i = j$ and $\phi_{ij} = 0$ if calculating the cross-price elasticities $i \neq j$.

Following Deaton and Muellbauer (1980), the expenditure elasticity is calculated by using the formula:

$$e_i = \frac{\beta_i}{w_i} + 1 \qquad (5)$$

Because budget share varies across commodity groups, the expenditure elasticities computed by using the equation (5) also vary across food categories. It is a convenient way to calculate demand elasticities of income.

Generally, there are several methods available to estimate the AIDS models, including SUR, OLS, and Maximum likelihood, depending on the way the general price index is calculated. In this paper, the general price index is computed by using Stone's price index that automatically satisfies the adding-up and symmetric conditions required for demand system. So it does not need to impose any cross-equation constraints in the system. To carry out the homogeneous test, OLS is sufficient for each single demand equation in the system (see more in Stone 1954 and Dunne et al. 1984).

III. Food Consumption and Data

III.1 Food Consumption

Vietnam is undergoing significant transition in every aspect. There are also substantial changes in food consumption patterns. The changes may be characterized by a reduction in intake of staple food such as rice, potato, and corn, and an increase in consumption of animal food like meat, sugar, fat, processed food, and fruit. The poor households are likely to eat more food that are rich in starches and less proteins, while households living in the mountainous areas are more likely to consume less rich protein food and fat. However, food consumption has significantly changed in both quantity and quality.

Data on food consumption obtained from the national survey in 2004 show that cereals are the main source of energy in the Vietnamese diet,

TABLE 1
Percentage of Expenditure Share on Food in 2002 and 2004

	2002	*2004*
Rice-cereal	29.3	29.0
Non-rice cereal	9.3	6.0
Meat	23.3	24.3
Fish	9.4	11.2
Proceed food	5.0	5.3
Vegetables	3.6	3.4
Fruit	2.0	2.9
Drink	5.7	5.7
Other food	12.3	12.2

SOURCE: General Statistical Office of Vietnam's website.

capturing 35 per cent of total expenditure for food. It decreases slightly from 2002 to 2004. The most important cereal is rice which is a staple food constituting a part of the daily meals in every region and every ethnic group. The expenditure for rice is 29 per cent of total food expenditure in 2004, while 6.3 per cent of total food expenditures are spent on vegetables and fruit. However, in some mountainous and highland areas where rice is not widely cultivated, the staple food is supplemented by tubers like sweet potato, cassava and corn. Table 1 also shows that expenditure share of animal products like meat and fishes have continuously increased from 32.7 per cent in 2002 to 35.5 per cent in 2004. In this category, there is a shift from white meat into red meat and from rich fat products into lower fat ones (Thang and Popkins 2004).

III.2 The Data

Data used in this paper is adapted from the Vietnam Household Living Standard Survey 2004, which was conducted by the Vietnamese General Statistical Office (GSO). The survey sample was selected to be representative for the whole country, taking into account urban and rural structures, geographical conditions, regional issues, organizational capacities, and provincial representatives. The survey collected information under the following topics: household information, education, health, employment, migration, housing, fertility and family planning, agricultural production, non-farm economic activities, food expenditures and consumption, non-food expenditures, durable goods, other income, borrowing, lending, and savings. The prices of three food categories used in this analysis are collected through their price indices and the average price levels which are available in the Community price survey, which was a part of 2004-VLSS and was simultaneously conducted. For heterogeneous categories, the price indices are calculated on average, by selecting some main products in the category.

In this paper, 9,189 households out of 9,192 households in the survey are used for analysis. Two households were removed because of missing values in income and expenditures. One household was removed because its income and expenditures are fifty-eight times as high as the average level, which leads us to believe that it is a coding error. Household expenditures for food are subjectively divided into three main categories: (1) rice-food includes expenditure on rice such as, normal rice, sticky rice, and special rice; (2) non-rice food consists of vegetables, fruits, drinks, and miscellaneous; (3) expenditure on meat/fish generally involves expenditures on all kinds of meat, poultry, fish and shrimp in both fresh and processed forms. Each food category includes two parts: self supply, and purchases, which are available in the dataset. Descriptive statistics show that the average share of rice food in total food expenditures is 19.8 per cent, while those figures for non-rice food and meat/fish are 35.5 per cent and 44.6 per cent respectively. In the extreme case, however, some poor households spent up to 62.9 per cent of food expenditures for rice, 65 per cent for non-rice food and 72.5 per cent for meat/fish. Of all observations, 75.5 per cent numbers of households are located in the rural areas, while 85.7 per cent household heads are male. All descriptive statistics of dataset are show in Table 2.

TABLE 2
Descriptive Statistics of Variables

Variables	*Mean*	*Std. Dev.*	*Min.*	*Max.*
Price index of rice	1.082	0.004	1.074	1.091
Price index of non-rice food	1.132	0.010	1.103	1.142
Price index of meat/fish	1.121	0.008	1.097	1.130
Rice expenditures	2577.110	1088.298	212.709	8169.847
Non-rice expenditures	4604.473	5236.645	310.058	8430.129
Meat/Fish expenditures	5792.380	17771.610	3862.531	9795.370
Non-food expenditures	10643.700	11294.030	52.434	162715.800
Gender of household head (male=1)	0.857	0.429	0.000	1.000
Age of household head	49.092	14.032	15.000	98.000
Education of household head	6.857	3.706	0.000	12.000
Location (urban=1)	0.245	0.430	0.000	1.000
Household size	4.401	1.731	1.000	20.000
Region 1[a]	0.212	0.408	0.000	1.000
Region 2	0.143	0.350	0.000	1.000
Region 3	0.047	0.211	0.000	1.000
Region 4	0.110	0.313	0.000	1.000
Region 5	0.093	0.290	0.000	1.000
Region 6	0.063	0.244	0.000	1.000
Region 7	0.129	0.336	0.000	1.000
Region 8	0.203	0.402	0.000	1.000
Quintile 1	0.199	0.399	0.000	1.000
Quintile 2	0.198	0.396	0.000	1.000
Quintile 3	0.204	0.401	0.000	1.000
Quintile 4	0.201	0.408	0.000	1.000
Quintile 5	0.198	0.396	0.000	1.000

NOTE: a. Since 2001 there are eight different economic regions in Vietnam: Northwest, Northeast, Red River Delta, North Central, South Central, Highland, Southeast, and Mekong River Delta.

IV. Estimating Demand for Food

To estimate demand for food by using the demand system approach, the AIDS model of equation (1) will be used in this paper. The system is estimated in two stages. In the first stage, the group of total expenditures consisting of non-food and food can be estimated by a system of two equations by using OLS. In the second stage, the expenditures for three food groups, including rice-food, non-rice food, and meat/fish are estimated via a system of three equations. The results from this system are used to test for homogeneity conditions and to calculate elasticities as well. Since the dependent variables of the systems sum up to one, they naturally satisfy the adding-up and symmetric conditions. Due to the calculation of price index presented in the previous section, the homogeneity needs to be tested.[1] By doing these tests, the two demand equations for non-rice and meat/fish satisfy both conditions, but rice food equation is marginally homogeneous. Based on the regression results from equation (1), we calculate income elasticity, compensated and uncompensated price

elasticities for the whole, urban and rural samples by using formulas (3), (4) and (5). Tables 3 and 4 present the elasticities for food categories in whole sample, rural, and urban areas.

For the whole sample, all elasticities have the right signs except for compensated own-price elasticity for non-rice demand. Although non-rice food has positive price elasticity, this coefficient appears to be consistent with that in other studies such as Deaton and Muellbauer (1980) and Gibson (1995), where they find positive price elasticity for non-cereal food. The first column shows that non-rice food is a luxury, while rice-food and meat/fish are normal goods. For rural areas, rice food is a normal good, but non-rice food and meat/fish are luxuries. In the urban areas, however, rice food is still a normal food but its income elasticity is much smaller compared to two other categories, while meat/fish is a normal, and non-rice food is still a luxury. It is understandable that households in rural areas have lower average incomes than households in urban areas. In addition, more than 99 per cent of the households surveyed consume rice food daily, around 22.5 per cent of people

TABLE 3
Income Elasticities, Compensated and Uncompensated Own-price Elasticities

	Uncompensated cross-prices elasticities			
		With respect to price of		
	Income elasticity	*Rice food*	*Non-rice food*	*Meat/fish*
Rice food	0.761	–0.334	0.393	–0.112
Non-rice food	1.257	–0.598	–0.451	–0.030
Meat/Fish	0.245	2.273	–3.978	–0.066
		Compensated cross-prices elasticities		
Rice food		–0.064	0.822	–0.051
Non-rice food		–0.296	0.028	0.039
Meat/Fish		2.363	–3.835	–0.046

TABLE 4
Income, Uncompensated Price Elasticities for Rural and Urban Areas

For rural areas	*With respect to price of*			
	Income elasticity	*Rice food*	*Non-rice food*	*Meat/fish*
Rice food	0.806	–0.471	0.536	0.090
Non-rice food	1.104	–0.376	–0.329	–0.327
Meat/Fish	1.068	1.471	–2.873	–0.054
For urban areas				
Rice food	0.012	–0.542	0.623	–0.538
Non-rice food	1.007	0.017	–0.296	–0.371
Meat/Fish	0.692	3.700	–1.736	–0.259

(mostly in rural areas) living in poor conditions, and many are barely above poverty, so their staple diet still consists of rice food. In this situation, income elasticity for food should be close to unity (FAO 1999).

Demands for three food categories are price inelastic for the whole and tow subsamples, but the magnitudes are slightly different. Demands for rice food and meat/fish are more price elastic while demand for non-rice food is less elastic in urban than in rural areas. It may imply that rural households are more dependent on rice food and meat/fish than urban households are, whereas urban households tendency for non-rice food is stronger than of rural households.

Income and price elasticities calculated for each household's income quintile[2] show how demand for food responds to changes in income and its prices. Those elasticities are presented in Table 5. These results suggest that the meat/fish products are luxuries for lower income groups but a normal good for the richest group. Rice food is a normal good for all income quintiles, while non-rice food is normal good for the poor, but a luxury for the rich in Vietnam. This result seems to be controversial. It is possible that the poor may self-supply some valuable non-rice foods with substantially low cost of production or consume low-price non-rice food with lower quality, while the rich, mostly living in the urban areas, have to buy at high prices and get higher quality non-food products. This result is exactly right for some kinds of fruits and some local specialties, and is consistent with the conclusion in Nguyen (2002). The demand for non-rice food is more responsive to the price and income changes of the poor and the rich, and it is less sensitive to a change in price for the middle class. It would be expected that the demand for non-rice food is determined by the limited income of households rather than their habit and taste. The fact is that there is a high proportion of poor households in Vietnam's population; so as the income rises, it is largely matched by rising expenditure on non-rice food that those households have not had sufficient amounts of so far.

The demand for rice is price-inelastic for all income quintiles. It does not exhibit a clear pattern across the income groups. The results may imply that rice is a staple for all Vietnamese people regardless whether they are the poor or rich. Demand for meat/fish does not show a specific pattern, but it is less price-elastic for the poor rather than for the rich.

In Vietnam, food consumption varies widely by regions, ethnic groups, culture, income, and agricultural production differences (FAO 1999). The determinants of food demand are briefly estimated by using the extended AIDS model presented in the equation (2). The results are presented in Table 6.

For the extended AIDS model, dependent variables are shares of three food categories and total food expenditures. The equation system passed the homogeneity test for non-rice food, meat/fish, and food demand functions. According

TABLE 5
Income and Own-price Elasticities of Demand for Food by Household Income Quintiles

		Quintile 1	*Quintile 2*	*Quintile 3*	*Quintile 4*	*Quintile 5*
Income elasticity of	Rice food	0.79	0.93	0.94	0.94	0.86
	Non-rice	0.88	0.89	0.92	1.02	1.20
	Meat/fish	2.75	2.07	1.86	1.12	0.22
Price elasticity of	Rice food	–0.44	–0.60	–0.42	–0.55	–0.44
	Non-rice	–0.82	–0.19	–0.22	–0.69	–0.67
	Meat/fish	–0.42	–0.58	–1.14	–2.16	–0.99

TABLE 6
Extended AIDS Coefficients for Food Consumption in Vietnam

	Rice food	*Non-rice*	*Meat/fish*	*Food*
Log of rice food price	0.154	–0.144	–0.009	–0.001
	(12.40)	(–7.28)	(–0.44)	(–0.12)
Log of non-rice food price	0.196	0.055	–0.141	0.027
	(2.02)	(0.36)	(–0.85)	(0.29)
Log of meat price	–0.050	–0.028	0.079	0.025
	(–4.11)	(–1.45)	(3.79)	(2.11)
Log of general price	–0.149	–0.048	0.197	0.086
	(–48.79)	(–9.84)	(38.05)	(29.19)
Gender of household head	0.011	0.008	–0.019	0.001
	(4.68)	(2.23)	(–4.86)	(0.24)
Age of household head	0.000	–0.001	0.001	0.000
	(–2.89)	(–5.60)	(7.00)	(1.36)
Education of household head	0.000	0.002	–0.002	–0.003
	(–2.89)	(5.64)	(–4.79)	(–12.22)
Urban	–0.026	0.173	–0.148	–0.019
	(–9.95)	(42.21)	(–33.97)	(–7.84)
Household size	0.036	0.021	–0.058	–0.020
	(55.09)	(20.13)	(–51.48)	(–31.10)
Region 1	–0.003	–0.038	0.041	0.043
	(–0.98)	(–7.45)	(7.61)	(14.11)
Region 2	0.027	–0.056	0.029	0.011
	(7.54)	(–9.70)	(4.71)	(3.26)
Region 3	0.055	–0.083	0.028	0.016
	(7.94)	(–7.50)	(2.40)	(2.40)
Region 4	–0.008	–0.031	0.039	0.018
	(–2.20)	(–5.33)	(6.32)	(5.31)
Region 5	–0.022	–0.017	0.039	0.022
	(–6.13)	(–2.92)	(6.38)	(6.23)
Region 6	–0.010	–0.012	0.022	0.009
	(–2.06)	(–1.50)	(2.63)	(1.98)
Region 7	–0.009	0.025	–0.016	0.001
	(–2.97)	(5.03)	(–3.00)	(0.29)
Quintile 2	0.010	0.093	–0.103	–0.042
	(2.83)	(17.07)	(–17.78)	(–12.73)
Quintile 3	0.012	0.152	–0.164	–0.070
	(3.37)	(27.46)	(–27.91)	(–21.09)
Quintile 4	0.000	0.218	–0.218	–0.100
	(0.01)	(37.59)	(–35.49)	(–28.61)
Quintile 5	–0.012	0.335	–0.323	–0.172
	(–2.69)	(47.70)	(–43.43)	(–40.86)
Intercept	1.417	0.632	–1.049	0.223
	(55.73)	(15.52)	(–24.32)	(9.14)

NOTE: Numbers in the parenthesis are t-values.

to the results, almost all coefficients are significant at 5 per cent. The expenditure shares on rice food, non-rice food, and meat/fish are increasing as their prices increase separately, but percentage change in expenditure shares is smaller than percentage change in price, if other things are constant. These results are consistent with their own-price inelastic demand of food categories in Tables 3 and 4.

The results also imply that the characteristics of household head like gender, education level, and age do not affect significantly food expenditure. This result is consistent with result found in Thang and Popkin (2004). An unsurprising result is that households in urban areas consume more non-rice food and less rice food and meat/fish than the households in rural areas. The total share of food in urban areas is also less than that of households in the rural areas. It is because urban residents have higher income, so they are willing to pay for non-rice food, which is a luxury good from Tables 3 and 4.

The household size does not have a clear effect on food expenditure shares. Expenditure shares for rice food and non-rice food increase by 0.036 and 0.021 percentage point respectively when there is one additional person in a household. Expenditure share for meat/fish decreases by 0.058 for every additional member in a household. Overall, one additional person makes expenditure share for food decrease by 0.020, if other things are held constant. These results may imply that other expenses paid for a newborn child has a large share of total expenditures comparing to food consumption.

Other results show that expenditure share on rice is highest for the poorest group, and it tends to be lower for richer groups. It implies that rice is a staple food for the poor. It becomes less important for higher income groups. This finding is not surprising because higher income households can consume more substitutes. There is an opposite trend in non-rice food.

V. Conclusions

This paper provides an empirical analysis of the demand for food in Vietnam in 2004 using the VLSS 2004. We estimated the income and price elasticities for three groups of food using the AIDS and the extended AIDS. The paper found that rice food is a normal good for all samples and income groups. This result may mean that demand for non-food in Vietnam would be a preference problem rather than income issues. Meat/fish is a normal good, but non-rice is a luxury. Rice food and meat/fish would be important and staple food for Vietnamese who have really low income. And the fact that Vietnamese are very sticky in consuming rice and rice food, so rice food consumption is a consumer's preference problem.

The results also showed that characteristics of household head such as age, gender, and education had little effect on food consumption, while location of household did have a significant effect on food expenditure and consumption. Information on elasticities could also provide policy-makers with an indication of how Vietnamese consumers react to changes in price and income. Such changes may arise directly through food policies, or from adjustment within the economy, which aims to alleviate food insecurity, and have a positive impact on nutrition by treating differently among groups of consumers.

NOTES

The author would like to thank Dr Dong Li for his useful suggestions and intellectual advice that make the paper more valuable, and two anonymous referees for their constructive comments and suggestions that improved the quality of this paper.

1. Homogeneity is satisfied if for all j in equations (1) and (2) as $\sum_k \alpha_k = 0$.

2. According to the survey, income quintile indicates that which expenditure quintile group a household belongs to: quintile 1 is poorest; quintile 2 is poor-mid; quintile 3 is middle; quintile 4 is mid-upper; quintile 5 is richest.

REFERENCES

Caswell, A. J. "The Determinants of Demand for Beef: The Impact of Fat Trimming ". In *The Economics of Reducing Health Risk from Food*. Washington, D.C., 1995.

Christensen, L. R., D. W. Jorgenson, and L. J. Lau, "Transcendental Logarithmic Utility Functions". *American Economic Review* 65 (1975): 367–83.

Deaton, A. and J. Muellbauer. "An Almost Ideal Demand System". *The American Economics Review* 70 (1980): 312–26.

Dunne, J. P., P. Pashardes, and R. P. Smith. "Needs, Costs, and Bureaucracy: The Allocation of Public Consumption in the UK". *Economic Journal* 94 (1984): 1–15.

Dunne, P. and B. Edkins. "The Demand for Food in South Africa". Economics Society South Africa Conference, Durban, 2005.

Eales, J. S. and L. J. Unnevehr. "Demand for Beef and Chicken Products: Separability and Structural Change". *American Journal of Agricultural Economics* 70 (1988): 521–32.

Edgerton, D. L., B. Assarsson, A. Hummelmose, I. P. Laurila, K. Rickertsen, and P. V. Halvor. *The Econometrics of Demand Systems with Application to Food Demand in the Nordic Countries*. Kluwer Academic Publisher, 1996.

FAO. *ENS-Nutrition country profiles*. Vietnam, 1999.

Figuie, M. "Vegetable Consumption Behaviors in Vietnam". In *Sustainable development of Peri-urban Agriculture in Southeast Asia*, 2003.

Gibson, J. "Food Consumption and Food Policy in Papua New Guinea". Institute of National Affairs, Port Moresby, 1995.

Hop L. T., L. B. Mai, and N. C. Khan. "Trends in Food Production and Consumption in Vietnam during the Period 1980–2000". The National Institute of Nutrition, Hanoi, 2003.

Karagiannis, G., S. Katranidis, and K. Velentzas. "An Error Correction Almost Ideal Demand System for Meat in Greece". *Agricultural Economics* 22 (2000): 29–35.

LaFrance, J. T. and T. K. M. Beatty. "A Model of Food Demand". IAMA World Food and Agribusiness Symposium, Sydney, Australia, 2001.

Nguyen D. H. *Kinh te trang trai gia dinh Viet Nam trong thoi ky cong nghiep hoa hien da hoa* [Family farm in the period of industrialization and modernization in Vietnam]. Hanoi: Statistical Publishing House, 2002.

Stone, J. R. N. "Linear Expenditure Systems and Demand Analysis: An Application to the Pattern of British Demand". *Economics Journal* 64 (1954): 511–27.

Thang, N. M. and M. B. Popkin. "Patterns of Food Consumption in Vietnam: Effects on Socioeconomic Groups during an Era of Economics Growth". *European Journal of Clinical Nutrition* 58 (2004): 145–53.

Theil, H. "The Information Approach to Demand Analysis". *Econometrica* 33 (1965): 67–87.

Le Quang Canh is an Assistant Professor of Development Economics in the National Economics University, Vietnam. He is currently pursuing a Ph.D. in Economics at the Department of Economics, Kansas State University, USA.